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(54) **SYSTEM AND METHOD FOR COMMUNICATING WITH A PORTABLE ELECTRONIC DEVICE**

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(52) **U.S. Cl.**
CPC ***H04B 7/15507*** (2013.01)

(58) **Field of Classification Search**
USPC 455/11.1
See application file for complete search history.

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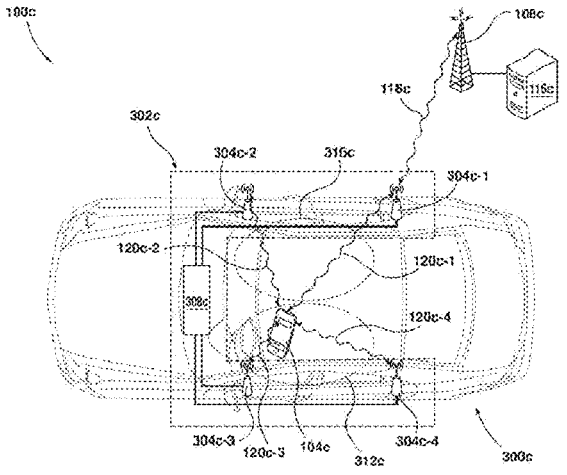
(57) **ABSTRACT**

A system and method for communicating with a portable electronic device are provided. The system includes a plurality of relay antennas mounted to a vehicle. The system further includes a processor in communication with the plurality of relay antennas to relay a communication message between the portable electronic device and a base station. The processor is also configured to locate the portable electronic device based on input data received from the plurality of relay antennas. The method involves establishing a communication link between the portable electronic device and a plurality of relay antennas. The method further involves relaying a communication message between the portable electronic device and a base station. The method also involves locating the portable electronic device based on input data from the plurality of relay antennas.

20 Claims, 14 Drawing Sheets



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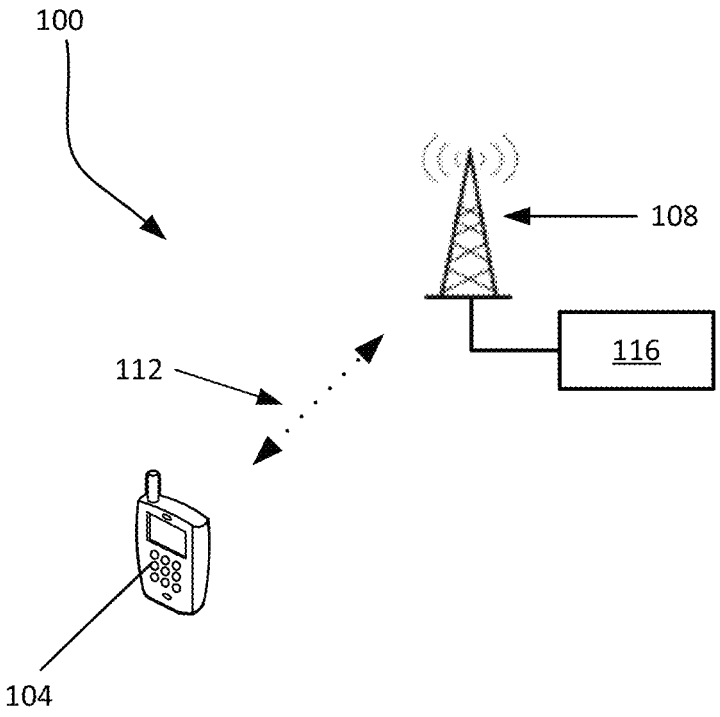


Figure 1

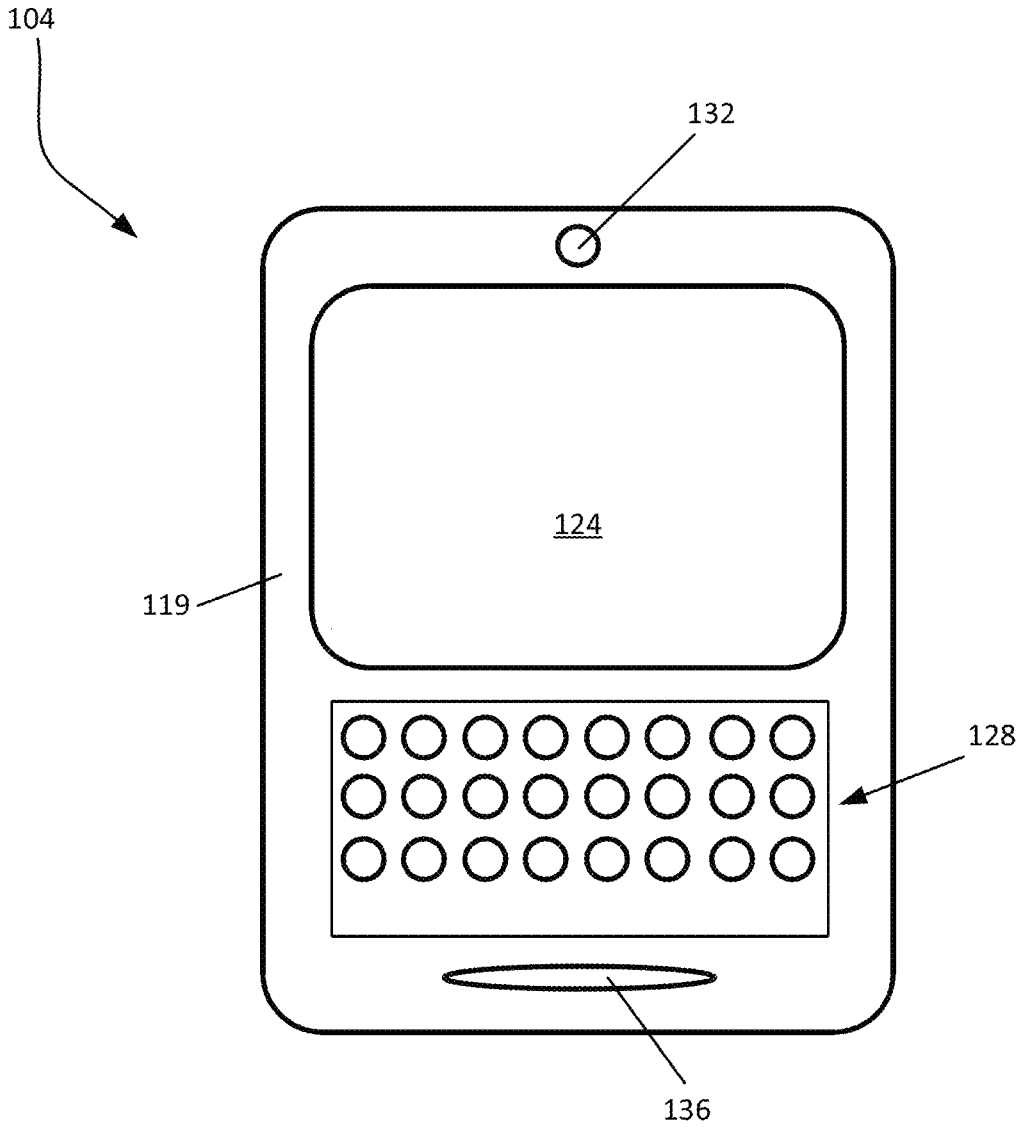


Figure 2

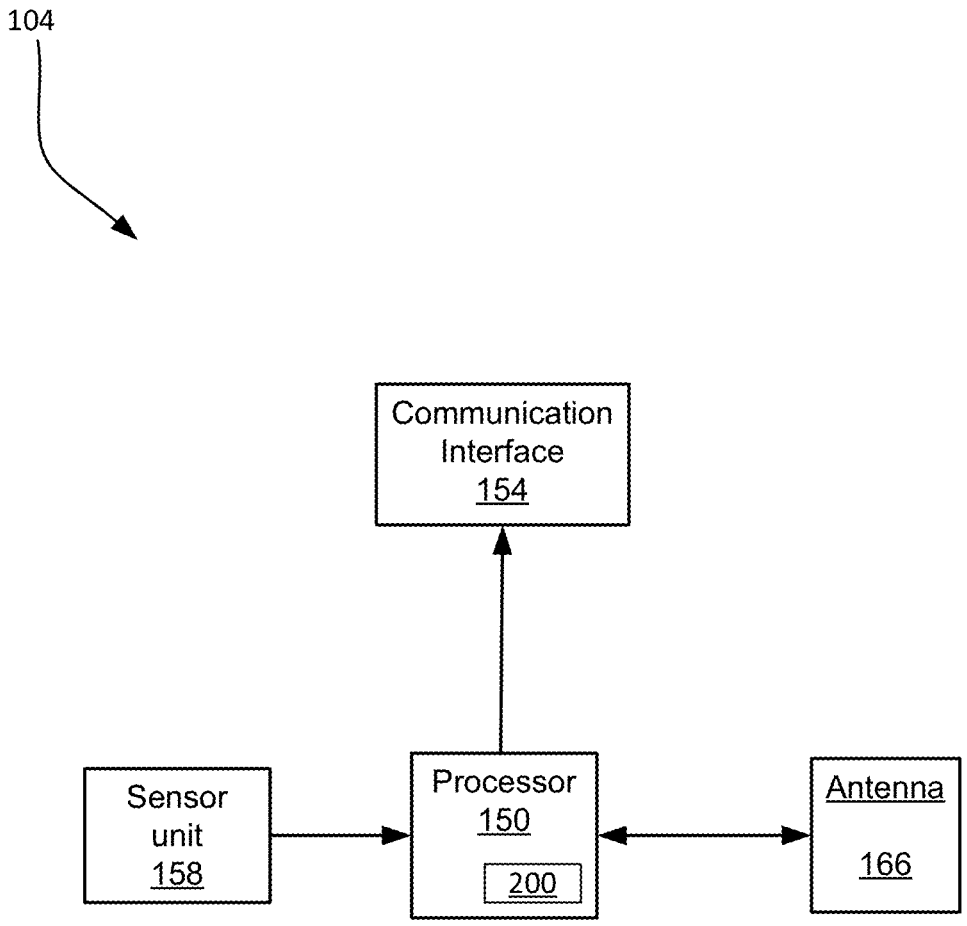

104
Communication Interface 154
Sensor unit 158
Processor 150
200
Antenna 166

Figure 3

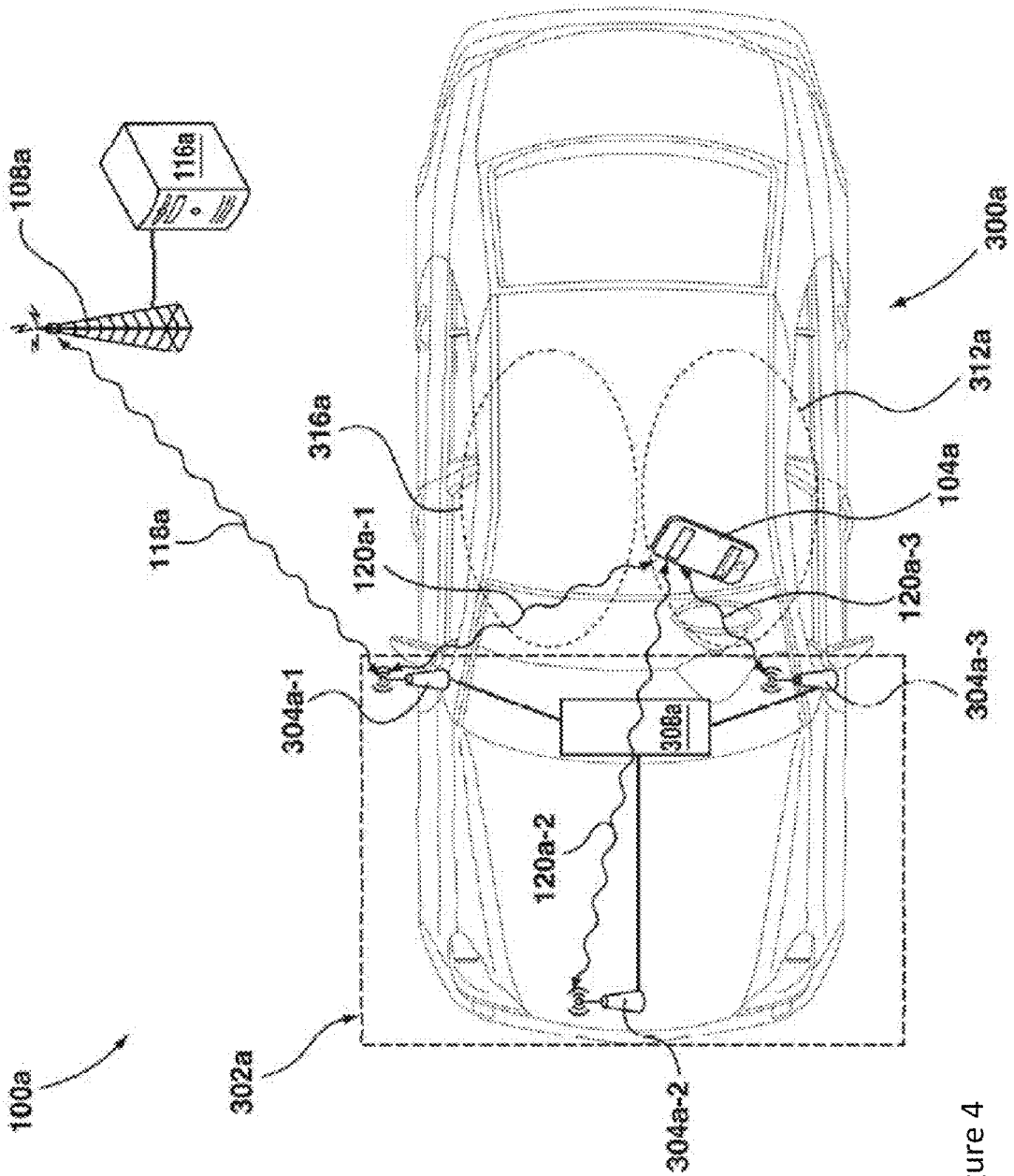

108a
116a
300a
312a
316a
104a
116a
120a-1
120a-3
304a-1
304a-3
308a
120a-2
100a
302a
304a-2

Figure 4

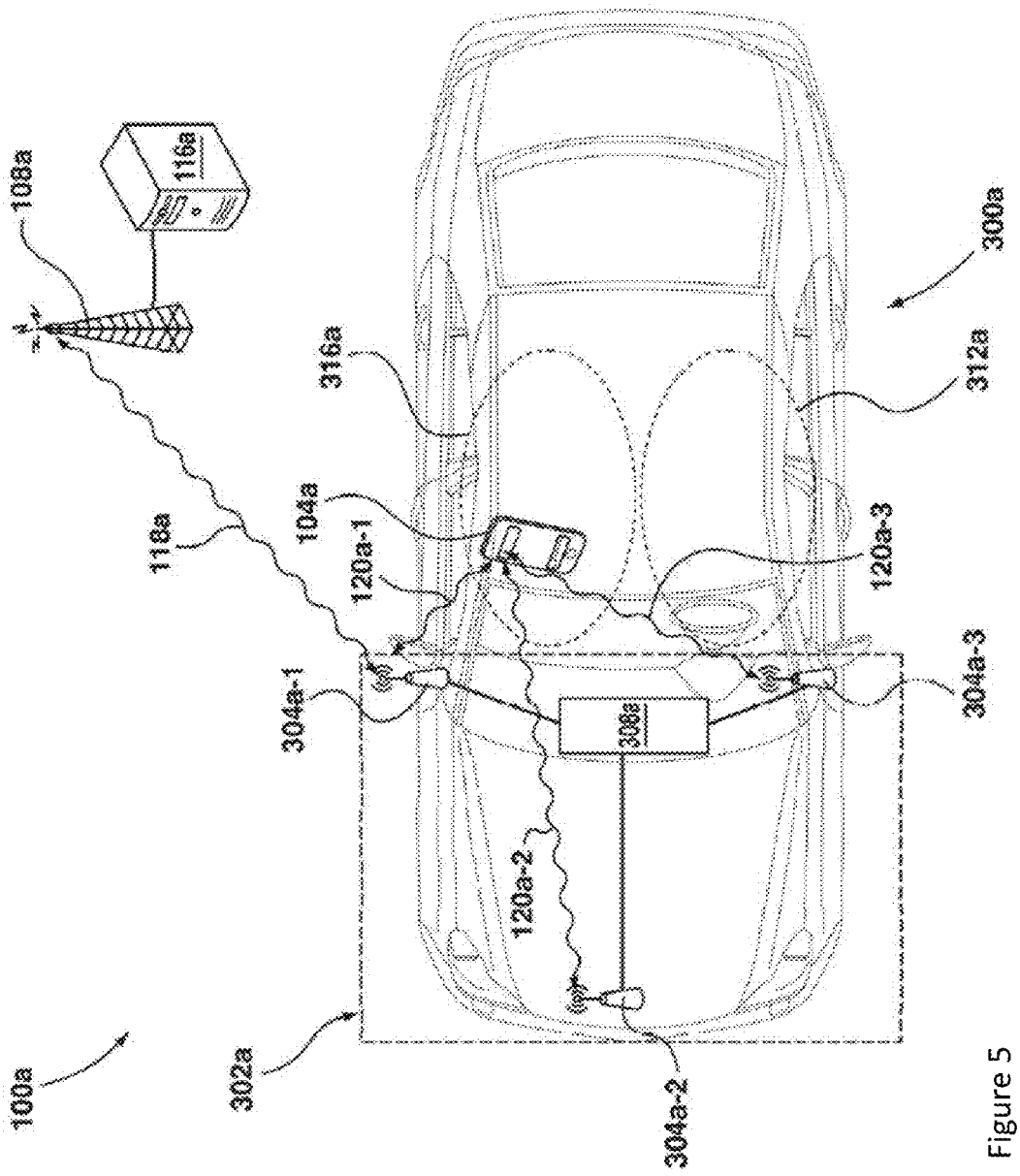

108a
116a
300a
316a
312a
104a
118a
120a-1
120a-3
304a-1
304a-3
306a
120a-2
100a
302a
304a-2

Figure 5

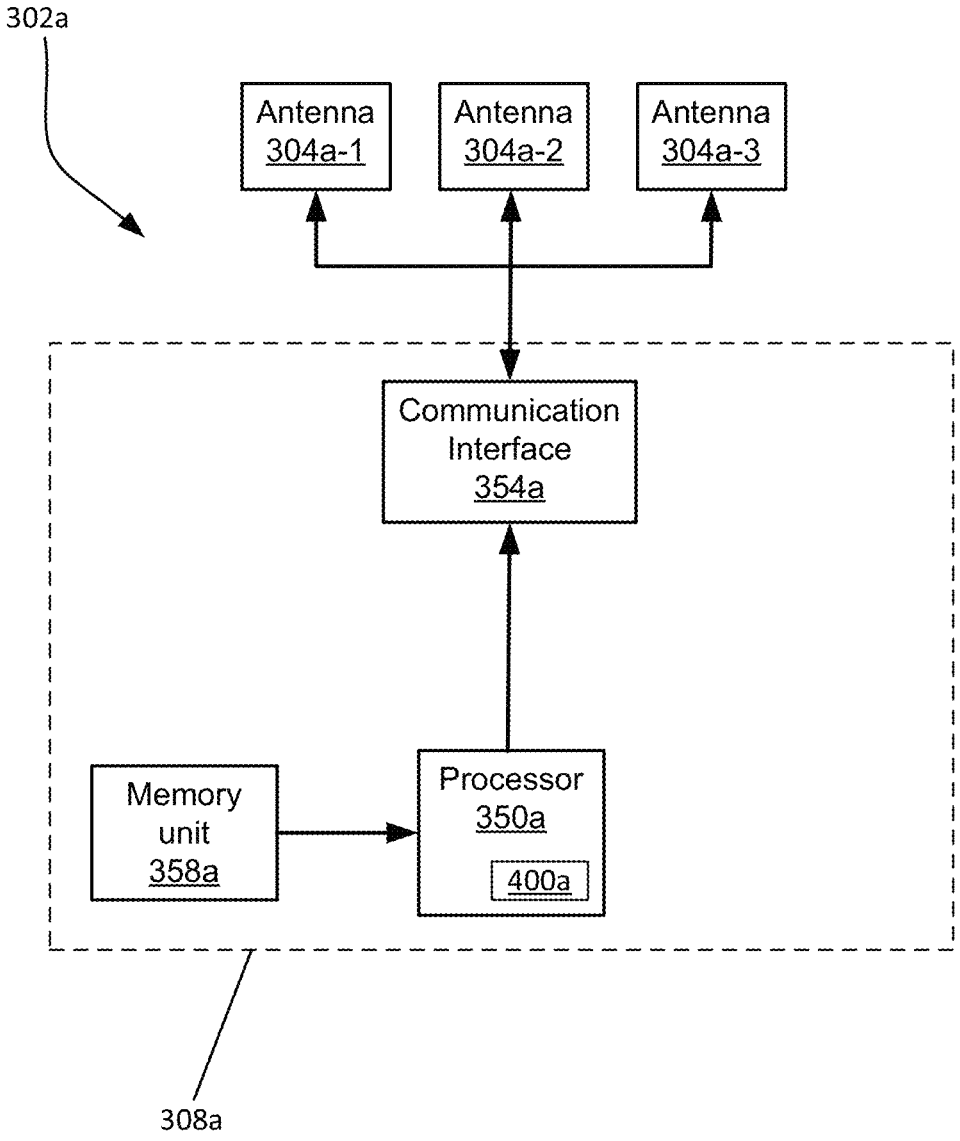

302a
Antenna
304a-1
Antenna
304a-2
Antenna
304a-3
Communication
Interface
354a
Memory
unit
358a
Processor
350a
400a
308a

Figure 6

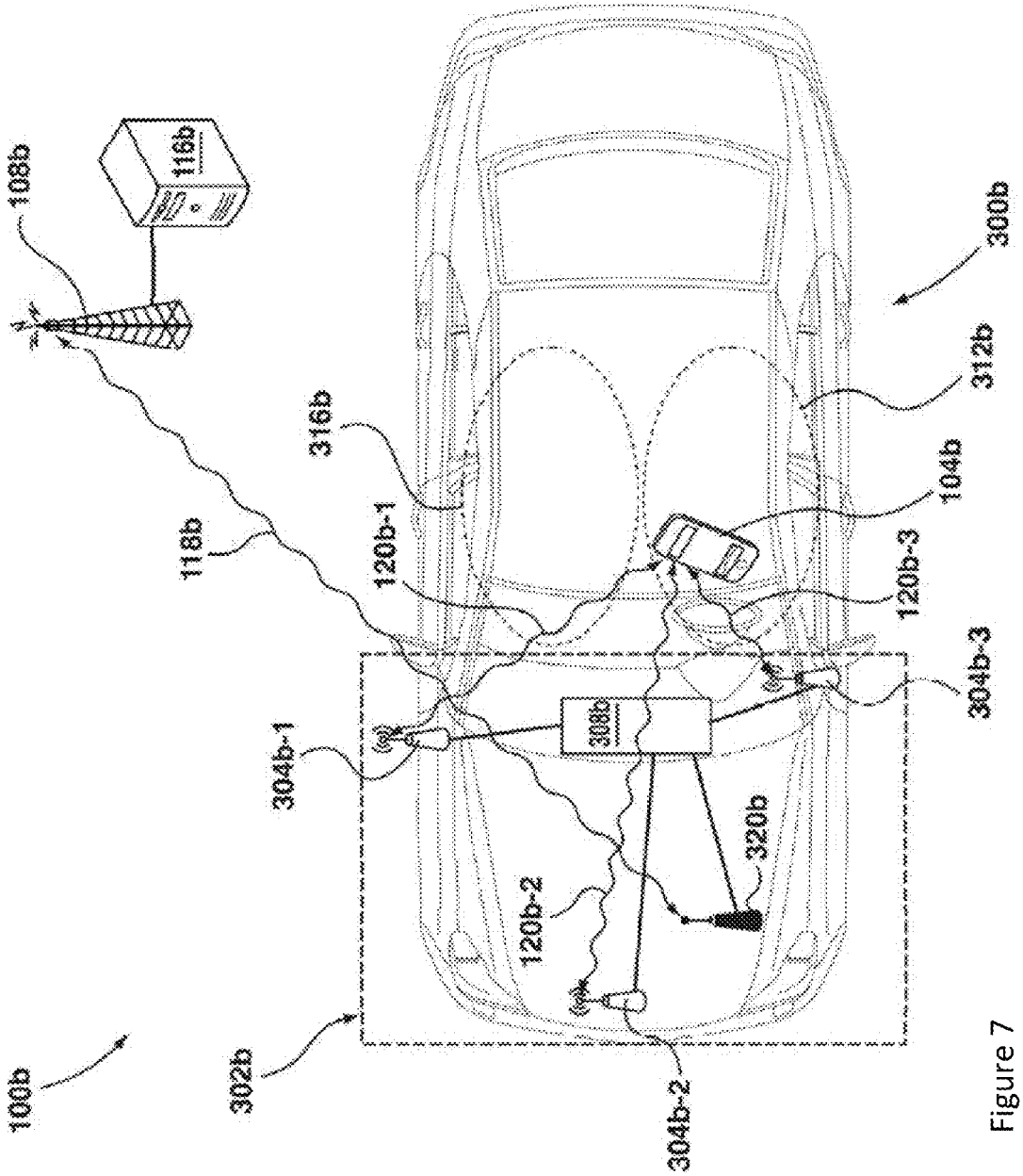
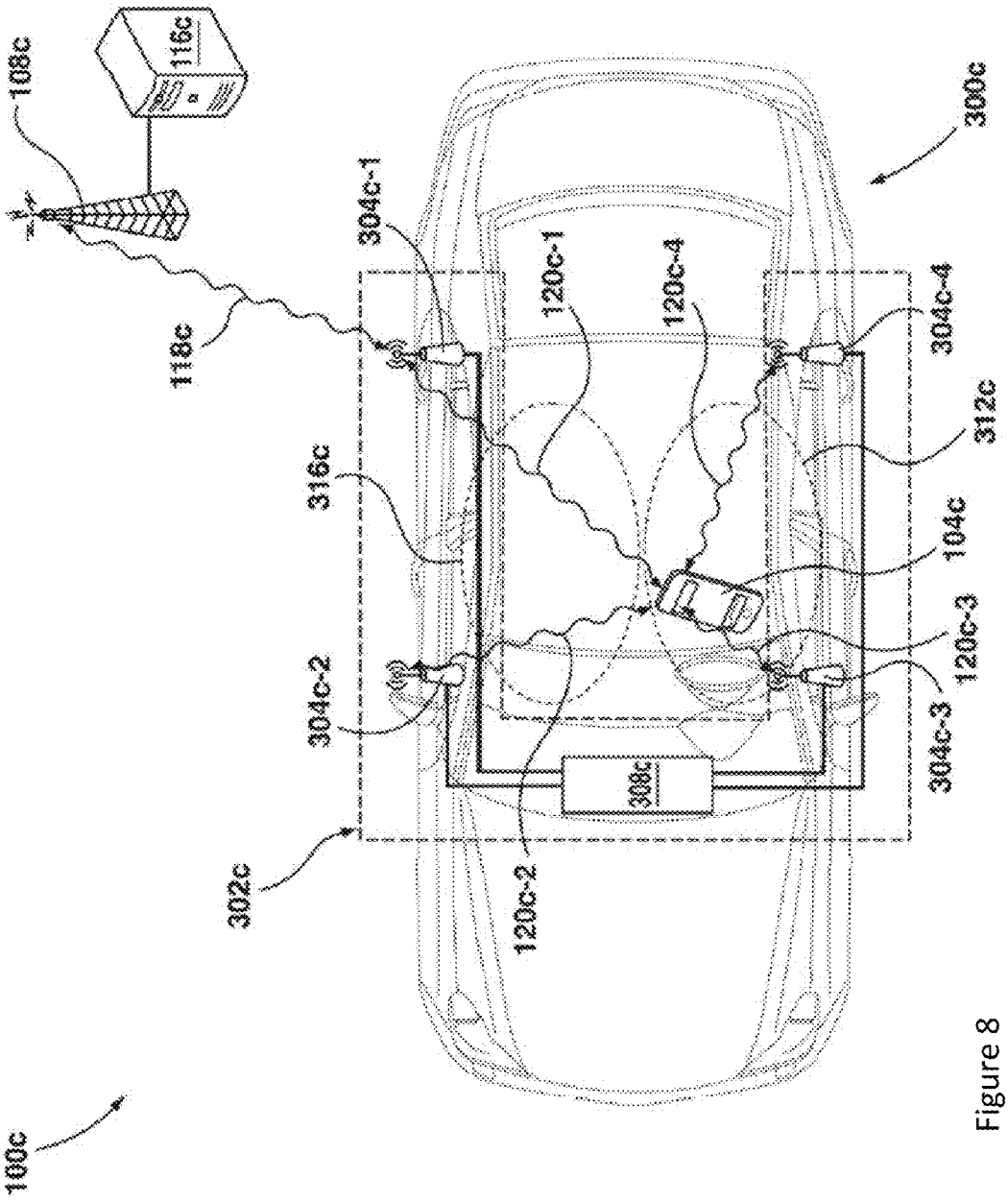

100b
108b
116b
118b
300b
302b
304b-1
304b-2
304b-3
308b
312b
316b
320b
104b
120b-1
120b-2
120b-3

Figure 7


100c
108c
116c
118c
300c
304c-1
120c-1
120c-4
304c-4
312c
316c
104c
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304c-2
304c-3
308c
302c
120c-2

Figure 8

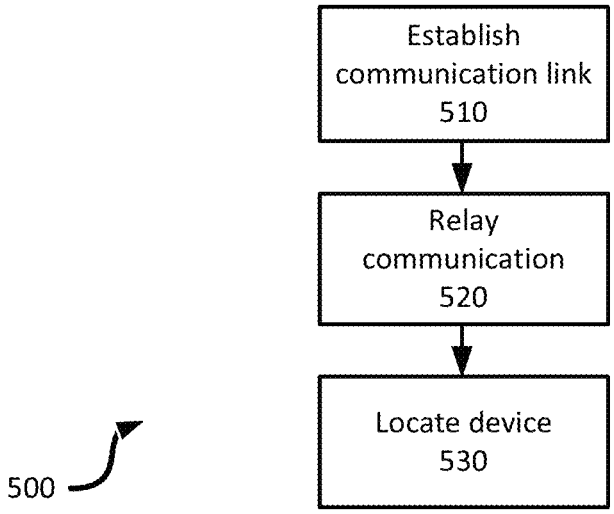
Establish communication link 510
Relay communication 520
Locate device 530
500

Figure 9

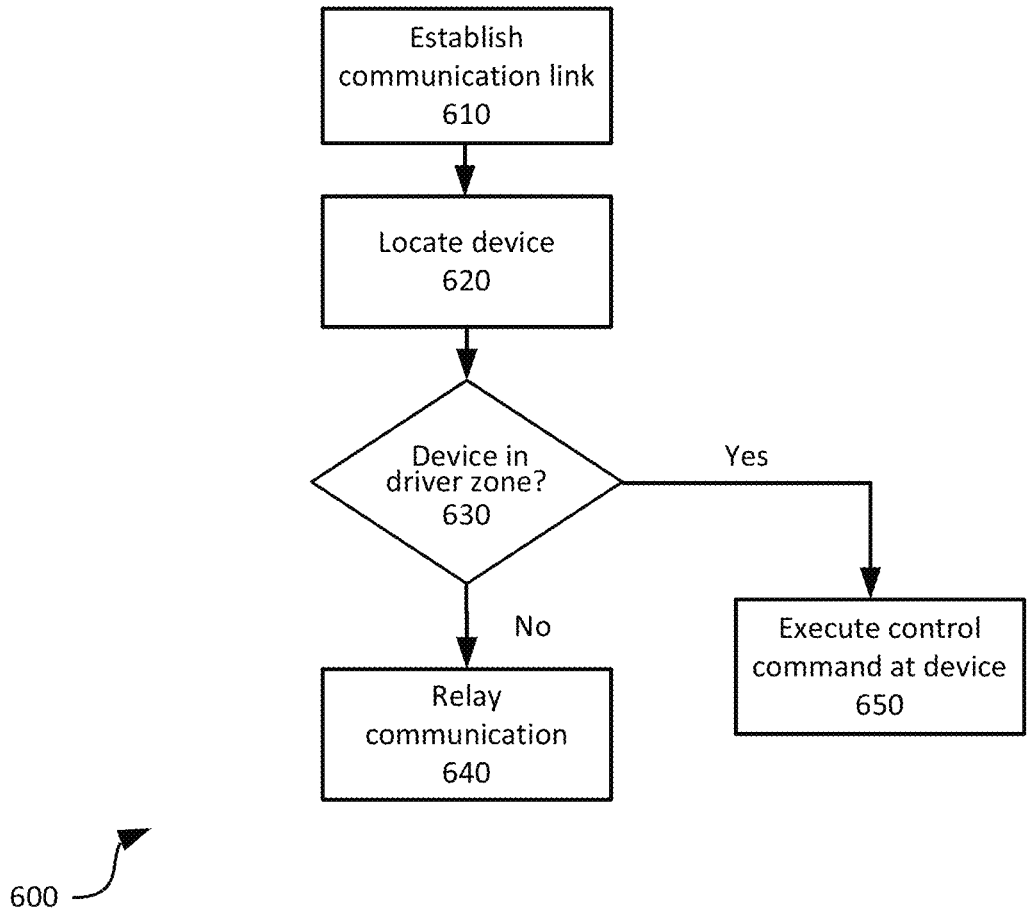
Establish communication link 610
Locate device 620
Device in driver zone? 630
Yes
No
Execute control command at device 650
Relay communication 640
600

Figure 10

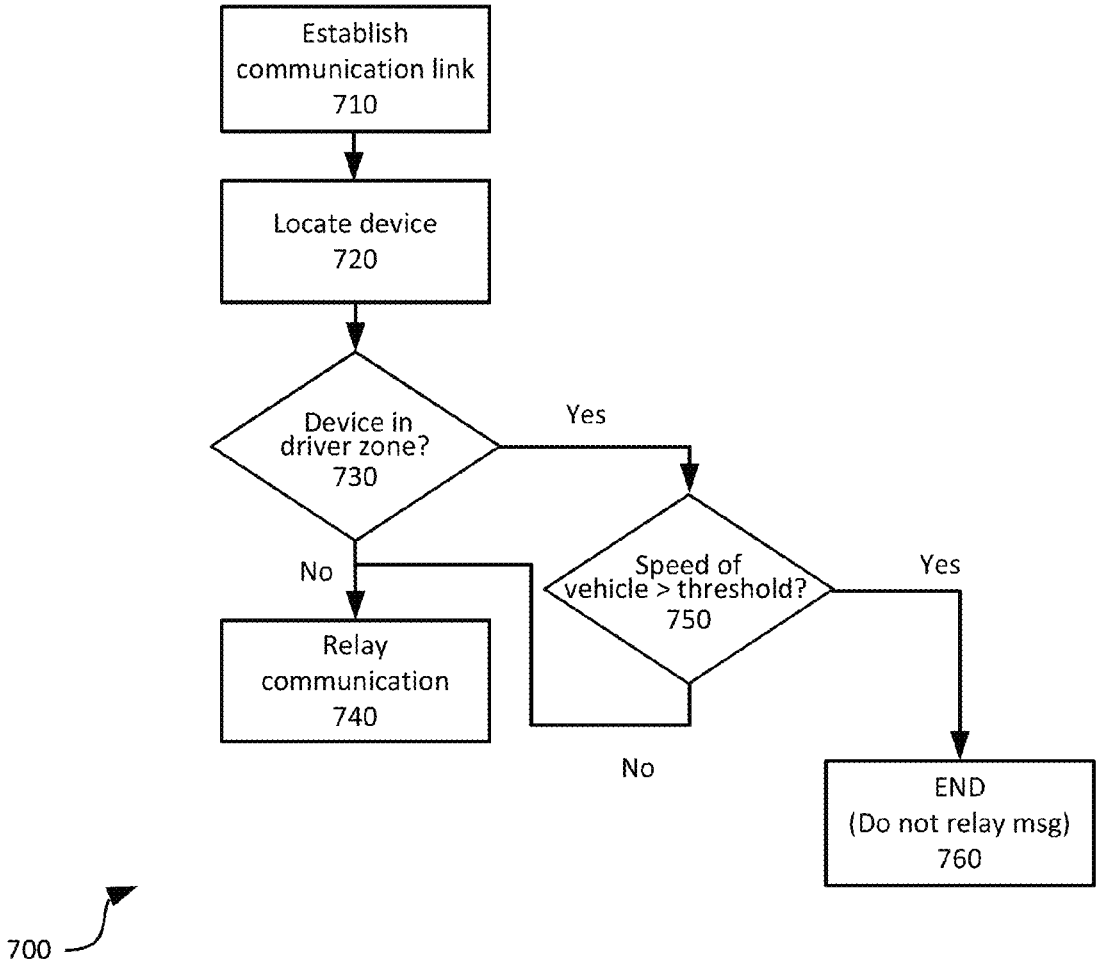
Establish communication link 710
Locate device 720
Device in driver zone? 730
Yes
No
Speed of vehicle > threshold? 750
Yes
No
Relay communication 740
END (Do not relay msg) 760
700

Figure 11

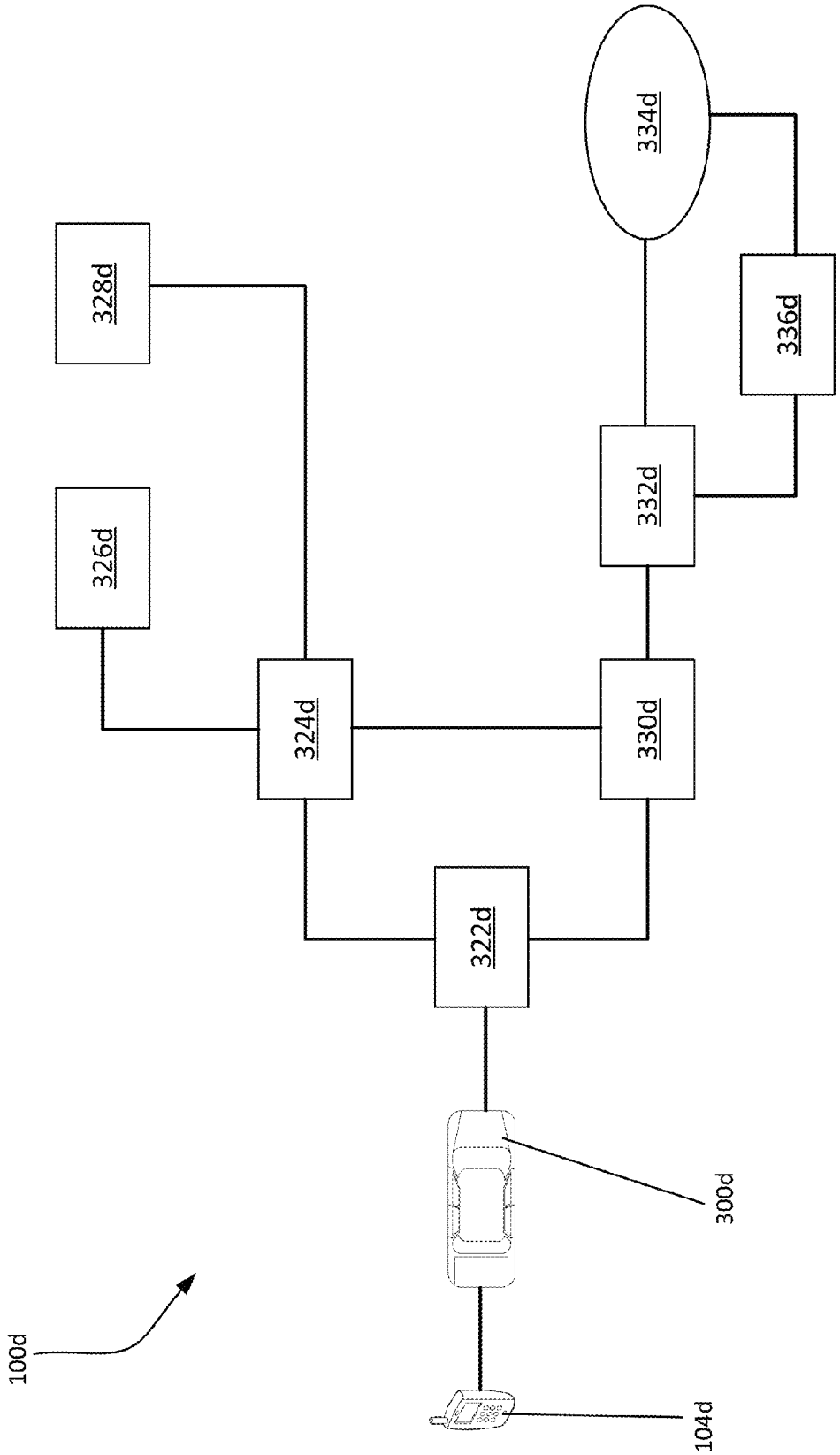

Figure 12

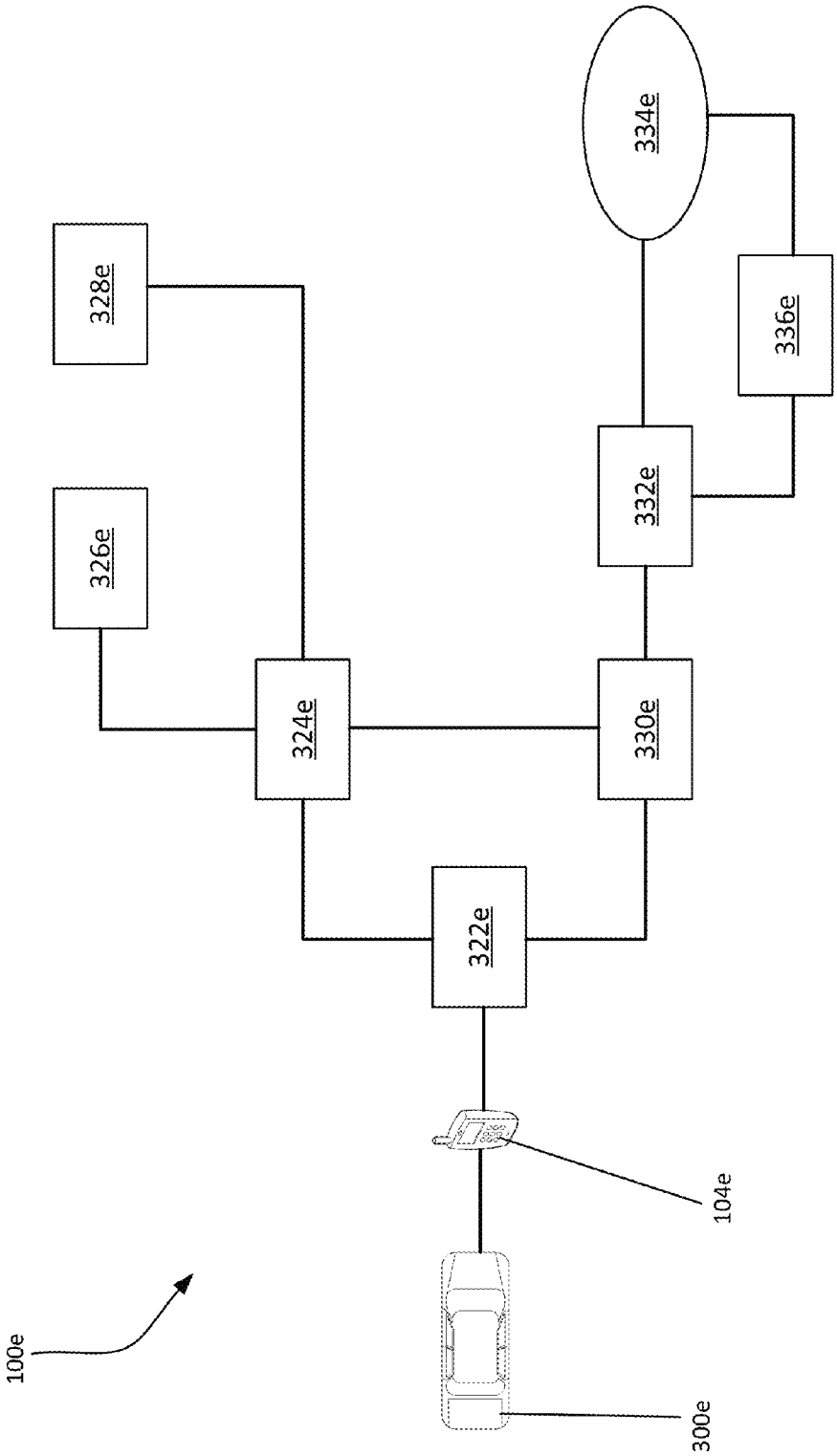

Figure 13

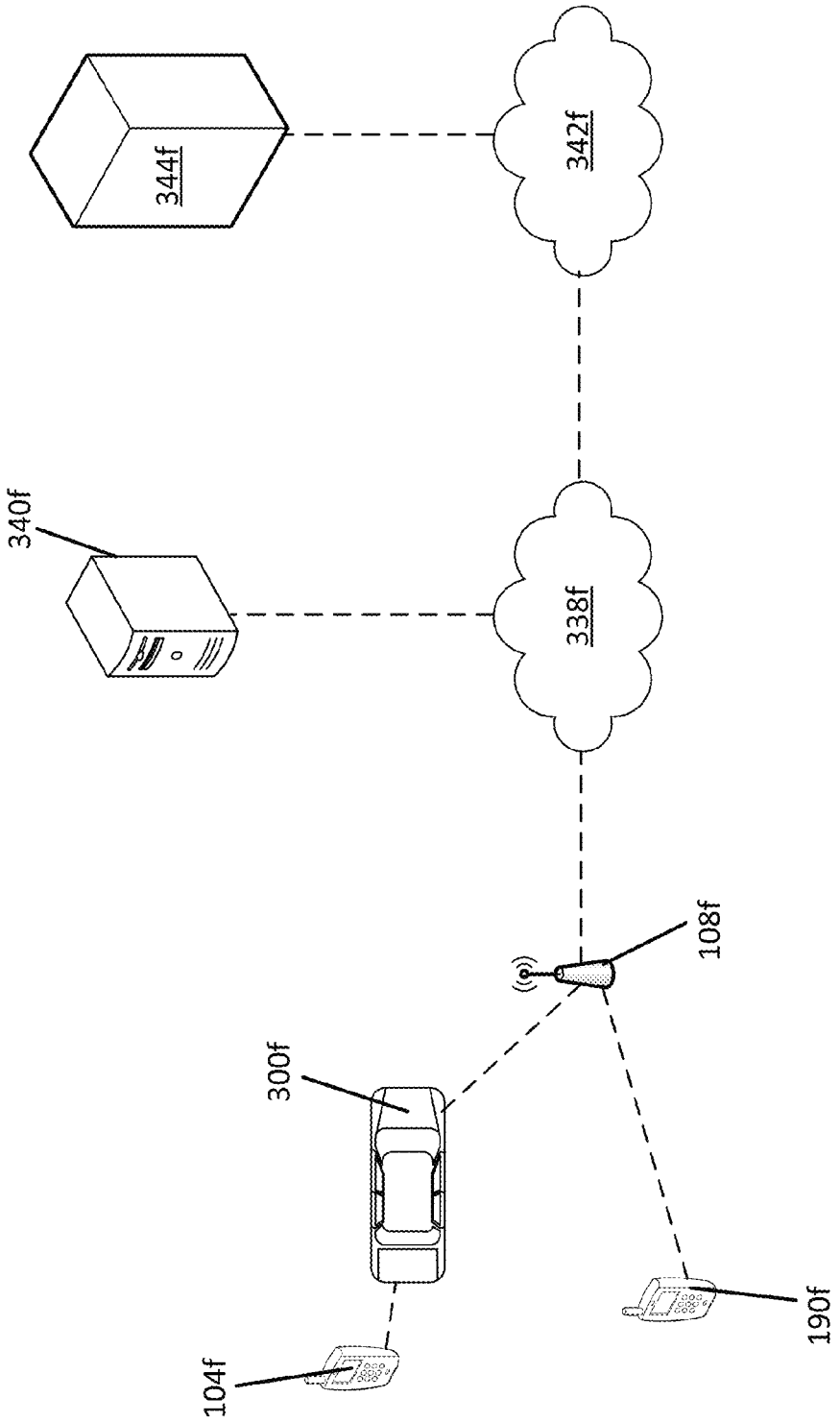

Figure 14

SYSTEM AND METHOD FOR COMMUNICATING WITH A PORTABLE ELECTRONIC DEVICE

FIELD

The present specification relates generally to systems for communicating with a portable electronic device, and more particularly to systems for managing features of a portable electronic device.

BACKGROUND

The evolution of portable electronic devices is currently quite active. As portable electronic devices evolve, portable electronic devices now include more functionality than ever before. It is now accepted that the increase in functionality and use of portable electronic devices can cause distraction by attracting attention and focus that should be directed to other tasks resulting in potential dangerous situations. For example, several jurisdictions across North America are now limiting the use of portable electronic devices while performing specific activities such as driving.

BRIEF DESCRIPTION OF THE DRAWINGS

Reference will now be made, by way of example only, to the accompanying drawings in which:

FIG. **1** is a schematic view of a system in accordance with an embodiment;

FIG. **2** is a front view of a portable electronic device in accordance with an embodiment;

FIG. **3** is a schematic block diagram of the portable electronic device shown in FIG. **2**;

FIG. **4** is a schematic view of a system in accordance with another embodiment;

FIG. **5** is a schematic view of the system of FIG. **4** with a different configuration;

FIG. **6** is a schematic block diagram of the relay system of FIGS. **4** and **5**;

FIG. **7** is a schematic view of a system in accordance with another embodiment;

FIG. **8** is a schematic view of a system in accordance with another embodiment;

FIG. **9** is a flow chart of a method in accordance with an embodiment;

FIG. **10** is a flow chart of a method in accordance with another embodiment;

FIG. **11** is a flow chart of a method in accordance with another embodiment;

FIG. **12** is a schematic view of a system in accordance with another embodiment;

FIG. **13** is a schematic view of a system in accordance with another embodiment; and

FIG. **14** is a schematic view of a system in accordance with another embodiment.

DETAILED DESCRIPTION OF THE EMBODIMENTS

In accordance with an aspect of the specification, there is provided a system for communicating with a portable electronic device. The system includes a plurality of relay antennas mounted to a vehicle. Each relay antenna of the plurality of relay antennas is configured to communicate with the portable electronic device. The system further includes a processor in communication with the plurality of relay antennas. The processor is configured to relay a communication message between the portable electronic device and a base station. The processor is further configured to locate the portable electronic device based on input data received from the plurality of relay antennas.

The processor may be configured to send a control message to the portable electronic device based on a location of the portable electronic device.

The control message may be for modifying a feature of the portable electronic device.

The system may further include a memory storage unit configured to store the communication message.

The processor may be configured to withhold the communication message associated with the modified feature of the portable electronic device. The processor may be further configured to store the communication message in the memory storage unit.

The system may further include a vehicle interface configured to receive a vehicle message from a vehicle computer.

The vehicle message may provide an indication of a speed of the vehicle.

The processor may be configured to send a control message to the portable electronic device based on a location of the portable electronic device and the speed of the vehicle.

The control message may be for modifying a feature of the portable electronic device.

The system may further include an external antenna in communication with the processor. The external antenna may be configured to communicate with the base station.

In accordance with an aspect of the specification, there is provided a method of communicating with a portable electronic device. The method involves establishing a communication link between the portable electronic device and a plurality of relay antennas. The method further involves relaying a communication message between the portable electronic device and a base station. The method also involves locating the portable electronic device based on input data from the plurality of relay antennas.

The method may further involve executing a control command at the portable electronic device based on a location of the portable electronic device.

Sending the control message may be for modifying a feature of the portable electronic device.

The method may further involve storing the communication message in a memory storage unit.

The method may further involve withholding the communication message associated with the modified feature of the portable electronic device

The method may further involve storing the withheld communication message in the memory storage unit.

The method may further involve receiving a vehicle message from a vehicle computer.

The vehicle message may provide an indication of a speed of the vehicle.

The method may further involve sending a control message to the portable electronic device based on a location of the portable electronic device and the speed of the vehicle.

The method may further involve communicating with the base station using an external antenna.

Referring now to FIG. **1**, a schematic representation of a non-limiting example of a system **100** for communicating with a portable electronic device is shown. It is to be understood that the system **100** is purely exemplary and it will become apparent to those skilled in the art that a variety of systems are contemplated. The system **100** includes a portable electronic device **104** for sending and receiving data

wirelessly, and a base station **108** for communicating with the portable electronic device **104** over a wireless transmission link **112**.

In the present embodiment, the base station **108** is part of a wireless network provided by a carrier. The wireless network provides access to other networks, such as the Internet or a telephone network, for the portable electronic device **104**. In particular, data is delivered to the portable electronic device **104** via the wireless transmission link **112** from the base station **108**. Similarly, data is sent from the portable electronic device **104** via the wireless transmission link **112** to the base station **108**. The base station can be connected to a server **116** for managing features of the portable electronic. The manner by which the server **116** manages the portable electronic device **104** is not particularly limited. For example, the server **116** can send command messages to the portable electronic device **104** to enable, modify, or disable features dependent on the location of the portable electronic device **104**.

It will be appreciated that the portable electronic device **104** is movable within a coverage area of the base station **108** and can be moved to coverage areas defined by other base stations (not shown). Furthermore, it is to be understood by one of ordinary skill in the art that wireless networks can include LTE, GSM/GPRS, CDPD, TDMA, iDEN Mobitex, DataTAC networks, EDGE or UMTS and broadband networks including variants of IEEE 802.11.

The portable electronic device **104** is generally configured to communicate with the base station **108** via the wireless transmission link **112**. In particular, the portable electronic device **104** is configured to receive content from the wireless transmission link **112** and generate associated output at the portable electronic device **104**. In addition, the portable electronic device **104** is also configured to receive input and send data associated with the input over the wireless transmission link **112**. For example, in the present embodiment, the portable electronic device **104** can receive data representing a voice communication from the wireless transmission link **112** to generate output at a speaker. In turn, the portable electronic device **104** can receive sound input from a microphone and send associated data over the wireless transmission link **112**. As another example, the portable electronic device **104** can also be configured to send and receive text messages such as SMS, MMS, email, etc. However, it is to be re-emphasized that the system shown in FIG. **1** is a non-limiting representation only. For example, although only one portable electronic device **104** is shown in FIG. **1**, it is to be understood that the system **100** can be modified to include a plurality of portable electronic devices **104**, each of the portable electronic devices **104** having its own wireless transmission link **112** to the base station **108** and individually managed by the server **116**. Furthermore, it is also to be understood that the portable electronic device **104** can be simultaneously connected to a plurality of base stations **108** if the portable electronic device **104** is within the range of more than one base station. Indeed, a plurality of different configurations of the system **100** is contemplated herein.

Referring to FIG. **2**, the portable electronic device **104** is shown in greater detail. It is to be understood that the portable electronic device **104** is purely exemplary and it will be apparent to those skilled in the art that a wide variety of portable electronic devices are contemplated. For example, variations on the portable electronic device **104** can include, without limitation, a cellular telephone, a portable email paging device, a camera, a portable music player, a portable video player, a personal digital assistant, a portable book reader, a portable video game player, a tablet computer, a netbook computer, a laptop computer, or an on board computer in a vehicle. Other contemplated variations include devices which are not necessarily portable, such as desktop computers. In the present embodiment, the portable electronic device **104** includes a chassis **119** that supports a display **124**, a plurality of keys **128**, a speaker **132** and a microphone **136**.

The chassis **119** is generally configured to support and protect the remaining components of the portable electronic device **104**. In terms of providing physical support, the chassis **119** is typically configured to be mechanically strong enough to provide a rigid or flexible support for the other components of the portable electronic device **104**. Furthermore, the chassis **119** is typically constructed such that it is rigid and strong enough to protect the internal components of the portable electronic device **104** from the elements and physical shock. In the present embodiment, it is to be understood that the chassis **119** is generally manufactured from a rigid and strong material such as plastic or metal protect internal components of from traumatic events such as being accidentally dropped. Alternatively, it is also to be understood that in other embodiments, the portable electronic device **104** can be modified to be a flexible device such that the chassis is also flexible.

The display **124** can comprise one or more light emitters such as an array of light emitting diodes (LED), liquid crystals, plasma cells, or organic light emitting diodes (OLED). Other types of light emitters are also contemplated. Furthermore, an optional touch membrane can be overlaid on the display **124** to provide a touchscreen input device.

In the present embodiment, the portable electronic device **104** includes a plurality of keys **128**. The arrangement of the plurality of keys **128** is not particularly limited. In some embodiments, the plurality of keys **128** includes keys associated with letters of the alphabet arranged in a QWERTY keyboard layout. In other embodiments, the plurality of keys can be associated with numbers and arranged in a numeric keypad layout. Furthermore, in other embodiments, the portable electronic device **104** can be modified to omit the plurality of keys **128**. In portable electronic devices without a plurality of keys, the portable electronic devices are generally configured to include a touchscreen display capable of receiving similar input using a virtual keyboard. Other types of input devices are also contemplated. For example, a touchpad, joystick, trackball, track-wheel, or optical camera or flex sensor or any one or more of them can be provided, in addition to or in lieu of the plurality of keys **128**.

The portable electronic device **104** also includes a speaker **132** for generating audio output in the present embodiment. Furthermore, the portable electronic device **104** also includes a microphone **136** for receiving audio input. It is to be appreciated in other embodiments of portable electronic devices, such as those without capabilities for providing voice communication, the speaker and microphone is be optional.

Referring to FIG. **3**, a schematic Block diagram of the electronic components of the portable electronic device **104** is shown. It should be emphasized that the structure in FIG. **3** is purely exemplary. The portable electronic device **104** includes a processor **150** running programming instructions **200**. In general, the programming instructions **200** are stored in a computer readable storage medium accessible by the processor **150**. The portable electronic device **104** also includes a communication interface **154**, a sensor unit **158**, and a device antenna **166**.

The processor **150** is generally configured to be in communication with the communication interface **154**, the sensor unit **158**, and the device antenna **166**. The processor **150** is configured to execute programming instructions **200** and to receive data from other components of the portable electronic

device **104**, which include the communication interface **154** as well as the sensor unit **158**. Furthermore, the processor **150** is also configured to send signals via the antenna **166**.

The processor **150** is connected to the communication interface **154**. The communication interface **154** is generally configured to connect an input or output device associated with the operation the portable electronic device **104**. The communication interface **154** is not particularly limited to any specific application. For example, the communication interface **154** can be used to connect the processor **150** with the display **124** for rendering visual output on the display. In addition, communication interface **154** can be used by the processor **150** to receive input data from the plurality of keys **128** or from the microphone **136**.

The processor **150** is further connected to the sensor unit **158** generally configured to receive a set data indicative of possible physical states. Therefore, the sensor unit **158** is always in "listening mode" and constantly receiving data from the environment of the portable electronic device **104**. Alternatively, in some embodiments, the sensor unit **158** can be modified to receive data during predetermined time periods. Outside of the predetermined time periods, the sensor unit **158** can be de-activated to conserve battery life. It is re-emphasized that the sensor unit **158** is not particularly limited and can include a single sensor or a plurality of sensors in the portable electronic device **104**. In addition, the sensor unit **158** can be modified such that it is not dedicated. For example, in some embodiments, the sensor unit **158** can be inactive to conserve power and activated by the processor **150**. Furthermore, the sensor unit **158** can include more than one type of sensor. For example, the sensor unit **158** can include at least one of an accelerometer, gyroscope, magnetometer, light sensor, proximity sensor, orientation sensor, altimeter, barometer, thermometer, gravity sensor, touch sensor, stress sensor, pressure sensor, a Hall Effect sensor, radio frequency (RF) power detector, voice detector, digital signal processing monitor, voltage standing wave ratio monitor, device detector, keyboard, touch input device, camera, GPS, and input received from a wireless transmission link.

In the present embodiment, the device antenna **166** is configured as a radio antenna for communicating over the wireless transmission link **112**. It will be understood that the device antenna **166** is configured to correspond with the network architecture that defines such the wireless transmission link **112** and that the device antenna **166** is capable of operating at a plurality of different frequencies. Commonly employed network architectures for the wireless transmission link **112** include, but are not limited to, Global System for Mobile communication ("GSM") at approximately one of 850 MHz, 900 MHz, 1800 MHz, or 1900 MHz, General Packet Relay Service ("GPRS"), Enhanced Data Rates for GSM Evolution ("EDGE"), 3G, High Speed Packet Access ("HSPA"), Code Division Multiple Access ("CDMA"), Evolution-Data Optimized ("EVDO"), LTE (Long Term Evolution), WiMax, ZigBee, Institute of Electrical and Electronic Engineers ("IEEE") standard 802.11, BLUETOOTH or any of their variants or successors.

In general terms, the processor **150** is generally configured to operate the portable electronic device **104** to provide communication. However, it is to be re-emphasized that the structure shown in FIGS. **2** and **3** are schematic, non-limiting representations only. For example, although the portable electronic device **104** shown in FIG. **3** shows the programming instructions being executed by the processor **150**, it is to be understood that the portable electronic device **104** can have a plurality of processors, each running programming instructions **200** or portions of programming instructions **200**.

Referring now to FIGS. **4** and **5**, a schematic representation of another non-limiting example of a system **100***a* for communicating with a portable electronic device is shown. Like components of the system **100***a* bear like reference to their counterparts in the system **100**, except followed by the suffix "a".

In the present embodiment, the base station **108***a* is part of a wireless network provided by a carrier. The wireless network provides access to other networks, such as the Internet or a telephone network, ultimately for a portable electronic device **104***a*. In the present embodiment, data is delivered to the portable electronic device **104***a* in a vehicle **300***a*. In FIG. **4**, the portable electronic device **104***a* is located within a driver zone **312***a* of the vehicle. In FIG. **5**, the portable electronic device **104***a* is located within a passenger zone **316***a*.

In the present embodiment, the vehicle **300***a* includes a relay system **302***a*. The relay system **302***a* includes central controller **308***a* in communication with a plurality of relay antennas **304***a*-**1**, **304***a*-**2**, and **304***a*-**3**. The central controller **308***a* sends and receives messages to the base station **108***a* using at least one of the plurality of relay antennas **304***a*-**1**, **304***a*-**2**, and **304***a*-**3** using a wireless transmission link **118***a*. In the present embodiment, the messages are relayed to the portable electronic device **104***a* using at least one or more of the plurality of relay antennas **304***a*-**1**, **304***a*-**2**, and **304***a*-**3** via wireless transmission links **120***a*-**1**, **120***a*-**2**, and **120***a*-**3**, respectively. It is to be appreciated that the same antenna communicating with the base station **108***a* can be used to relay messages to the portable electronic device **104***a*. Alternatively, separate antennas of the plurality of relay antennas **304***a*-**1**, **304***a*-**2**, and **304***a*-**3** can be used to send and to receive messages to the base station **108***a* and the portable electronic device **104***a*.

The exact type and the configuration of each relay antenna **304***a*-**1**, **304***a*-**2**, or **304***a*-**3** is not particularly limited. For example, in the present embodiment, the plurality of relay antennas **304***a*-**1**, **304***a*-**2**, and **304***a*-**3** are configured to communicate with the portable electronic device **104***a* using communication standards such as LTE, GSM/GPRS, CDPD, TDMA, iDEN Mobitex, DataTAC networks, EDGE or UMTS. However, in other embodiments the plurality of relay antennas **304***a*-**1**, **304***a*-**2**, and **304***a*-**3** can be configured to communicate using broadband networks including variants of IEEE 802.11 or BLUETOOTH. It is to be appreciated that by positioning the plurality of relay antennas **304***a*-**1**, **304***a*-**2**, and **304***a*-**3** closer to the portable electronic device **104***a*, less power is used to maintain the wireless transmission links **120***a*-**1**, **120***a*-**2**, and **120***a*-**3** compared with the power used to maintain the wireless transmission link **118***a* with a base station typically much further from the portable electronic device **104***a*. Therefore, it is to be understood, with the benefit of the above description, that power consumption at the portable electronic device **104***a* can be reduced by using the relay system **302***a*.

In general, the plurality of relay antennas **304***a*-**1**, **304***a*-**2**, and **304***a*-**3** are mounted to the vehicle **300***a*. The manner by which the plurality of relay antennas are mounted to the vehicle **300***a* is not particularly limited and can involve several different mechanisms by which an antenna can be mounted. For example, the plurality of relay antennas **304***a*-**1**, **304***a*-**2**, and **304***a*-**3** can be mounted to a surface inside the vehicle **300***a* using adhesive materials. As another example, the plurality of relay antennas **304***a*-**1**, **304***a*-**2**, and **304***a*-**3** can be mounted on a surface using a fastener such as a screw, nail, clamp or nut and bolt combination. Furthermore, the plurality of relay antennas **304***a*-**1**, **304***a*-**2**, and **304***a*-**3** can be mounted on the exterior of the vehicle **300***a*. It is to be appre-

ciated that the mounting mechanism and location of each of the antennas **304***a*-**1**, **304***a*-**2**, or **304***a*-**3** does not need to be identical and that a wide variety of different mechanisms and locations can be used in combination.

Referring to FIG. **6**, a schematic Block diagram of the relay system **302***a* showing the electronic components of the central controller **308***a* is provided. It should be emphasized that the structure in FIG. **6** is purely exemplary. The central controller **308***a* includes a processor **350***a* running programming instructions **400***a*. In general, the programming instructions **400***a* are stored in a computer readable storage medium accessible by the processor **350***a*. In the present embodiment, the central controller **308***a* also includes a communication interface **354***a*, and a memory unit **358***a*.

The processor **350***a* is generally configured to be in communication with the communication interface **354***a* and the memory unit **358***a*. The processor **150** is configured to execute programming instructions **400***a* and for receiving data from the plurality of relay antennas **304***a*-**1**, **304***a*-**2**, and **304***a*-**3** via the communication interface **354***a*.

The communication interface **354***a* is generally configured to connect an input or output device associated with the operation the central controller **308***a*. The communication interface **354***a* is not particularly limited to any specific application. For example, the communication interface **354***a* can be used to connect the processor **350***a* with the plurality of relay antennas **304***a*-**1**, **304***a*-**2**, and **304***a*-**3** as in the present embodiment. In addition, communication interface **354***a* can be used by the processor **350***a* to send and receive data, such as messages to a vehicle computer (not shown). The processor **350***a* can be configured to receive data from the vehicle computer relating to the vehicle such as the vehicle speed. Alternatively, the processor **350***a* can be configured to send messages to the vehicle computer to control features of the car such as the radio, navigation system, or climate control.

The processor **350***a* is further connected to the memory unit **358***a* generally configured to store data. In the present embodiment, the memory unit **358***a* is configured to store data, such as messages, received from the base station **108***a* before sending to the portable electronic device **104***a*. For example, if the portable electronic device **104***a* is in a state that is unable to receive messages as discussed in greater detail below, the messages can be stored in the memory unit **358***a* until the portable electronic device **104***a* can receive messages. As another example, the memory unit **358***a* can be configured to store data for maintaining a log or transcription of communications between the portable electronic device **104***a* and the base station **108***a*.

The programming instructions **400***a* cause the processor **350***a* to receive input from the plurality of relay antennas **304***a*-**1**, **304***a*-**2**, and **304***a*-**3** via the communication interface **354***a*. The programming instructions **400***a* direct the processor **350***a* to analyze the set of data to determine a location of the portable electronic device **104***a* within the vehicle **300***a*. For example, the processor **350***a* can determine whether the portable electronic device **104***a* is within the driver zone **312***a* (as shown in FIG. **4**) or the passenger zone **316***a* (as shown in FIG. **5**). The programming instructions **400***a* are not particularly limited to any one method of locating the portable electronic device **104***a*. For example, the portable electronic device **104***a* can be located by comparing the time of arrival for a radio signal from the portable electronic device **104***a* at each of the antennas **304***a*-**1**, **304***a*-**2**, and **304***a*-**3** to triangulate the location of the portable electronic device **104***a*. As another example, the intensity of the signals received at each of the antennas **304***a*-**1**, **304***a*-**2**, and **304***a*-**3** can also be used.

Once the location of the portable electronic device **104***a* is determined, the programming instructions **400***a* can proceed to direct the processor **350***a* to send a control message to the portable electronic device **104***a* for controlling the portable electronic device **104***a*. In the present embodiment, the control message is configured to disable or to modify a feature of the portable electronic device **104***a* when the portable electronic device is determined to be in the driver zone **312***a*. For example, if the portable electronic device **104***a* is a mobile phone, the control message can be used to disable SMS text messaging capabilities of the mobile phone. It is to be appreciated that the control message is not particularly limited and that in other embodiments, the control message can be configured to enable certain features of the portable electronic device **104***a* or the control message can be omitted completely for embodiments where only the location of the portable electronic device **104***a* is desired.

In general terms, the central controller **308***a* is generally configured to relay a message from the base station **108***a* to the portable electronic device **104***a* to reduce power consumption at the portable electronic device **104***a*. In addition, the central controller **308***a* is configured to locate the portable electronic device **104***a* within the vehicle **300***a* based on input data received from the plurality of relay antennas **304***a*-**1**, **304***a*-**2**, and **304***a*-**3**. It is to be appreciated that in some embodiments, the location of the portable electronic device **104***a* as determined by the central controller **308***a* can be provided upon an external request or uploaded to the server **116***a* for publication.

It is to be re-emphasized that the structure shown in FIG. **6** is a schematic, non-limiting representation only. For example, although the central controller **308***a* shown in FIG. **6** shows the programming instructions **400***a* being executed by the processor **350***a*, it is to be understood that the central controller **308***a* can have a plurality of processors, each running programming instructions **400***a* or portions of programming instructions **400***a*. Furthermore, it is also to be appreciated that in some embodiments where messages are not withheld from the portable electronic device **104***a*, the memory unit **358***a* can be omitted from the central controller **308***a*.

Furthermore, the system **100***a* is generally configured for communicating with a portable electronic device **104***a*. It is to be re-emphasized that the structure shown in FIGS. **4** to **6** is a non-limiting representation only. Notwithstanding the specific example, it is to be understood that other equivalent structures involving equivalent components can be devised to perform the same function as the system **100***a*. For example, the vehicle **300***a* is not particularly limited to any type of vehicle. In the present embodiment, the vehicle **300***a* is shown to be an automobile with a driver zone **312***a* and a passenger zone **316***a*. In other embodiments, the number of zones can be greater than two such that different control messages are generated for each zone. Furthermore, the vehicle **300***a* is not limited to an automobile and can be modified to be a truck, bus, train, aircraft, boat, ship or any other machine used to transport passengers or cargo.

Referring to FIG. **7**, a schematic representation of another non-limiting example of a system **100***b* for communicating with a portable electronic device is shown. Like components of the system **100***b* bear like reference to their counterparts in the system **100***a*, except followed by the suffix "b" instead of "a". The system **100***b* includes a base station **108***b*, a server **116***b* in communication with vehicle **300***b* via a transmission link **118***b* between the base station **108***b* and a relay system **302***b*. The relay system **302***b* includes a plurality of relay antennas **304***b*-**1**, **304***b*-**2**, and **304***b*-**3** communicating with

the portable electronic device **104***b* via transmission links **120***a*-**1**, **120***a*-**2**, and **120***a*-**3**, respectively. The vehicle **300***b* also includes a driver zone **312***b* and a passenger zone **316***b*.

In the present embodiment, the vehicle **300***b* includes a relay system **302***a* having an external antenna **320***b* configured to communicate with the base station **108***b*. The external antenna **320***b* is in communication with the central controller **308***b* similar to the plurality of relay antennas **304***b*-**1**, **304***b*-**2**, and **304***b*-**3**. In the present embodiment, the external antenna **320***b* is modified from the plurality of relay antennas **304***b*-**1**, **304***b*-**2**, and **304***b*-**3** to accommodate for differences between communicating with the base station **108***b* and the portable electronic device **104***b*. For example, since the base station **108***b* is generally at a much greater distance from the external antenna **320***b* than the portable electronic device is from any one of the plurality of relay antennas **304***b*-**1**, **304***b*-**2**, and **304***b*-**3**, the external antenna is capable of handling more power. Therefore, in the present embodiment, the plurality of relay antennas **304***b*-**1**, **304***b*-**2**, and **304***b*-**3** can be configured to be exclusively used for communicating with the portable electronic device **104***b*. Furthermore, it is to be appreciated that the vehicle **300***b* can be modified to include more than one external antenna **320***b*. By installing more external antennas on the vehicle **300***b*, the central controller **308***b* can communicate better with the base station **108***b*.

Referring to FIG. **8**, a schematic representation of another non-limiting example of a system **100***c* for communicating with a portable electronic device is shown. Like components of the system **100***c* bear like reference to their counterparts in the system **100***a*, except followed by the suffix "c" instead of "a". The system **100***c* includes a base station **108***c*, a server **116***c* in communication with vehicle **300***c* via a transmission link **118***c* between the base station **108***c* and a relay system **302***c*. The relay system **302***c* includes a plurality of relay antennas **304***c*-**1**, **304***c*-**2**, **304***c*-**3**, and **304***c*-**4** communicating with the portable electronic device **104***c* via transmission links **120***c*-**1**, **120***c*-**2**, **120***c*-**3**, and **120***c*-**4**, respectively. The vehicle **300***c* also includes a driver zone **312***c* and a passenger zone **316***c*.

In the present embodiment, the vehicle **300***c* includes the fourth relay antenna **304***c*-**4**. It is to be appreciated that the system **100***c* functions in a similar manner as the system **100***a*. The addition of the extra relay antenna **304***c*-**4** to the vehicle **300***c* provides increased precision to the localization of the portable electronic device **104***c*. It is to be appreciated that the number of relay antennas is therefore not limited to three or four, but can include a large number of antennas. However, mounting more antennas in the vehicle **300***c* uses more physical space within the vehicle **300***c* to which the antennas need to be mounted. Alternatively, it is also to be appreciated that the number of antennas can be fewer than three where the precise location of the portable electronic device is not required. For example, two antennas can be used to determine if the portable electronic device **104***c* is on the left side or the right side of the vehicle **300***c*. As another example, a single antenna can be used to determine whether the portable electronic device **104***c* is beyond a predetermined threshold distance from the single antenna to define two zones or more zones.

Referring now to FIG. **9**, a method for communicating with a portable electronic device **104***a* is represented in the form of a flowchart and indicated generally at **500**. In the present embodiment, the method **500** can be implemented using the system **100***a*. However, it is to be understood that the method **500** is not limited to the system **100***a* and can be implemented on a wide variety of systems, such as the system **100***b* and the system **100***c*. Furthermore, the following discussion of the method **500** will lead to further understanding of the system **100***a* and its various components. Although some blocks of the method **500** are indicated as occurring within certain components of the system **100***a*, it is to be understood that the system **100***a* or the method **500** can be varied, and need not work as discussed herein in conjunction with each other. In addition, it is to be appreciated that the method **500** need not be performed in the exact sequence as shown, hence the elements of the method are referred to herein as "blocks" rather than "steps". For example, a person skilled in the art will appreciate with the benefit of these teachings that the order of some blocks can be interchanged and that some blocks can also be performed in parallel.

Beginning at Block **510**, the central controller **308***a* establishes a communication link via the plurality of relay antennas **304***a*-**1**, **304***a*-**2**, and **304***a*-**3** with the portable electronic device **104***a*. In the present embodiment, the communication link includes the wireless transmission links **120***a*-**1**, **120***a*-**2**, and **120***a*-**3** established between each of the plurality of relay antennas **304***a*-**1**, **304***a*-**2**, and **304***a*-**3** to the portable electronic device **104***a*, respectively. However, it is to be appreciated that not all three wireless transmission links **120***a*-**1**, **120***a*-**2**, and **120***a*-**3** need to be established. For example, only two of the three wireless transmission links **120***a*-**1**, **120***a*-**2**, and **120***a*-**3** can be used to establish the communication link between the portable electronic device and the plurality of relay antennas **304***a*-**1**, **304***a*-**2**, and **304***a*-**3** such that one of the antennas are not in use.

Block **520** comprises relaying a communications message between the portable electronic device **104***a* and the base station **108***a*. The manner in which the communication message are relayed is not particularly limited and can involve various methods of communications using various communication standards. In the present embodiment, the central controller **308***a* can be configured to simply route the communication message between the portable electronic device **104***a* and the base station **108***a* while merely acting as an amplifier for amplifying a signal from the portable electronic device **104***a* and for transmission to the base station **108***a*. It is to be appreciated that due to the proximity of the portable electronic device **104***a* to the plurality of relay antennas **304***a*-**1**, **304***a*-**2**, and **304***a*-**3**, a relatively weaker signal can be generated by the portable electronic device **104***a* to transmit the communication message to the central controller **308***a*. Therefore, the portable electronic device **104***a* uses less power to send the communication message than if the portable electronic device **104***a* were to communicate directly with the base station **108***a*. Since the central controller **308***a* is powered with a power supply of the vehicle **300***a*, power optimization is less of a concern.

It is to be re-emphasized that the relaying operation is not particularly limited and that other methods of relaying a communication method are contemplated. For example, in other embodiments, relaying the communications message can involve the central controller **308***a* processing the communication message between the base station **108***a* and the portable electronic device **104***a*. For example, sending and receiving the communication message between the central controller **308***a* and the base station **108***a* can involve using a first standard suitable for long range communication, such as LTE, GSM/GPRS, CDPD, TDMA, iDEN Mobitex, DataTAC networks, EDGE or UMTS. In contrast, sending and receiving the communication message between the central controller **308***a* and the portable electronic device **104***a* can involve using a second standard suitable for short range communication, such as BLUETOOTH or WIFI. Furthermore, it is to be appreciated, with the benefit of this specification, that more

than one communication message can be relayed and the communication messages can be relayed simultaneously or sequentially.

Block **530** comprises locating the portable electronic device **104***a* based on input data received from the plurality of relay antennas **304***a*-**1**, **304***a*-**2**, and **304***a*-**3**. The input data is not particularly limited and can include a variety of different types. In the present embodiment, the input data includes the communication messages generated by the portable electronic device **104***a*. In other embodiments, the input data can include a signal sent from the portable electronic device **104***a* in response to a request from the central controller **308***a*.

The portable electronic device **104***a* can be located using various methods that are not particularly limited. In the present embodiment, electromagnetic signals are used to transmit the messages between the central controller **308***a* and the portable electronic device **104***a*. Therefore, several characteristics of the signals receive at the plurality of relay antennas **304***a*-**1**, **304***a*-**2**, and **304***a*-**3** can be used to locate the portable electronic device such as propagation time, timing advance, time difference of arrival, reference signal time difference, and angle of arrival, received signal strength. For example, the central controller **308***a* can use an observed time difference of arrival method, where the central controller **308***a* measures reference signal time difference on different signals received from multiple antennas of the vehicle. The location of the portable electronic device **104***a* can then be calculated by using a multilateration technique.

It is to be re-emphasized that the locating operation is not particularly limited and that variations are contemplated. For example, although the localization is described above to be carried out on the central controller **308***a*, the portable electronic device **104***a* can carry out similar methods to locate its position by interacting with the plurality of relay antennas **304***a*-**1**, **304***a*-**2**, and **304***a*-**3**, for example, when the relative positions of the plurality of relay antennas **304***a*-**1**, **304***a*-**2**, and **304***a*-**3** is known to the portable electronic device **104***a*.

In another embodiment, the locating operation can be carried out by a combination of the central controller **308***a* and the portable electronic device **104***a*. For example, input data can be received by the central controller **308***a* from the plurality of relay antennas **304***a*-**1**, **304***a*-**2**, and **304***a*-**3**. The input data can be transmitted to the portable electronic device **104***a*, which carries out one of the locating methods described above based on the input data received from the central controller **308***a*. Alternatively, the input data can be collected by the portable electronic device **104***a* interacting with known relative positions of the plurality of relay antennas **304***a*-**1**, **304***a*-**2**, and **304***a*-**3**. The input data collected by the portable electronic device **104***a* can be transmitted to the central controller **308***a*, which carries out one of the locating methods described above based on the input data received from the portable electronic device **104***a*. It is to be appreciated that the use of either the central controller **308***a* or the portable electronic device **104***a* for carrying out the locating operation based on the input data can be determined based on the relative available processing capabilities of the central controller **308***a* or the portable electronic device **104***a*.

In further embodiments, the input data can be collected by both the portable electronic device **104***a* and the central controller **308***a* for processing at one or both of the portable electronic device **104***a* and the central controller **308***a*. It is to be appreciated, with the benefit of this description, that by using input data from both the portable electronic device **104***a* and the central controller **308***a*, the precision to which the locating operation can determine the position of the portable electronic device **104***a* can be increased. Furthermore, in embodiments where both the central controller **308***a* and the portable electronic device **104***a* determine a location, the location determined by each of the central controller **308***a* and the portable electronic device **104***a* can be compared to verify the location as part of an error detection operation.

Referring now to FIG. **10**, another method or communicating with a portable electronic device **104***a* is represented in the form of a flowchart and indicated generally at **600**. In the present embodiment, the method **600** can be implemented using the system **100***a*. However, it is to be understood that the method **600** is not limited to the system **100***a* and can be implemented on a wide variety of systems, such as the system **100***b* and the system **100***c*. Furthermore, the following discussion of the method **600** will lead to further understanding of the system **100***a* and its various components as well as understanding other uses for the system **100***a*. Although some blocks of the method **600** are indicated as occurring within certain components of the system **100***a*, it is to be understood that the system **100***a* or the method **600** can be varied, and need not work as discussed herein in conjunction with each other. In addition, it is to be appreciated that the method **600** need not be performed in the exact sequence as shown, hence the elements of the method are referred to herein as "blocks" rather than "steps". For example, a person skilled in the art will appreciate with the benefit of these teachings that the order of some blocks can be interchanged and that some blocks can also be performed in parallel.

Beginning at Block **610**, the central controller **308***a* establishes a communication link via the plurality of relay antennas **304***a*-**1**, **304***a*-**2**, and **304***a*-**3** with the portable electronic device **104***a*. The manner in which the Block **610** establishes a communication link is not particularly limited and can include the manners discussed in connection with Block **510**.

Block **620** comprises locating the portable electronic device **104***a* based on input data received from the plurality of relay antennas **304***a*-**1**, **304***a*-**2**, and **304***a*-**3**. The manner by which the Block **620** locates the portable electronic device is not particularly limited and can include the manners discussed above in connection with Block **530**.

Block **630** comprises determining whether the portable electronic device **104***a* is located within the driver zone **312***a*. The manner by which the determination can be made is not particularly limited. In the present embodiment, the central controller **308***a* stores a table of predefined locations which are within the driver zone **312***a*. The location obtained from the execution of Block **620** is used as the location of the portable electronic device **104***a*. The central controller **308***a* uses the location and compares it with the table of predefined locations which are within the driver zone **312***a*. If the location does not match any location in the table, the execution of Block **630** results in "no" and lead to Block **640**. Alternatively, if the location matches a location in the table, the execution of Block **630** results in "yes" and lead to Block **650**.

It is to be re-emphasized that the determination operation described in Block **630** is not particularly limited and that several variations are contemplated. For example, instead of using a table of discrete locations, the central controller **308***a* can store ranges of coordinates which define the borders of the driver zone **312***a*. As another variant, Block **630** can be carried out at the portable electronic device **104***a* instead of at the central controller **308***a* using results of Block **620** carried out by the central controller **308***a*. The location can subsequently be sent to the portable electronic device **104***a* where the determination operation can be carried out. Alternatively, the portable electronic device **104***a* can carry out Block **620** while the central controller **308***a* carries out Block **630**.

Block **640** comprises relaying communications messages between the portable electronic device **104***a* and the base station **108***a*. The manner by which the Block **640** relays communications messages is not particularly limited and can include the manners discussed above in connection with Block **520**.

Block **650** comprises executing a control command at the portable electronic device **104***a*. In the present embodiment, the control command is generated at the central controller **308***a* and transmitted to the portable electronic device **104***a* as a control message. The control command is not particularly limited. In the present embodiment, the control command is configured to cause the portable electronic device **104***a* to enable, modify, or disable specific features. For example, if the portable electronic device **104***a* is in the driver zone **312***a*, features such as phone calls, emails, instant messaging, video players, GPS navigation, and other programs capable of running on the portable electronic device **104***a* can be modified or disabled if the portable electronic device **104***a* is within the driver zone **312***a* to reduce distraction.

It is to be emphasized that Block **650** described above is not particularly limited and that several variations are contemplated. In other embodiments, the control message can be omitted if the determination made at Block **630** was carried out at the portable electronic device **104***a*. Furthermore, although the above example describes executing a control command on the portable electronic device **104***a* when the portable electronic device **104***a* is in the driver zone **312***a*, a control command can be executed when the portable electronic device **104***a* is in the passenger zone **316***a* or any other zone of the vehicle **300***a*.

In other embodiments, the control message can also be generated at the base station **108***a* and relayed to the portable electronic device **104***a* via the central controller **308***a*. In such embodiments, the central controller **308***a* relays the location of the portable electronic device **104***a* from the execution of Block **620** to the server **116***a* connected to the base station **108***a* which returns the control message in response. It is to be appreciated that such embodiments provide a centralized location from which to send the control messages where policy changes regarding the control messages can be easily made.

Referring now to FIG. **11**, another method or communicating with a portable electronic device **104***a* is represented in the form of a flowchart and indicated generally at **700**. In the present embodiment, the method **700** can be implemented using the system **100***a*. However, it is to be understood that the method **700** is not limited to the system **100***a* and can be implemented on a wide variety of systems, such as the system **100***b* and the system **100***c*. Furthermore, the following discussion of the method **700** will lead to further understanding of the system **100***a* and its various components as well as understanding other uses for the system **100***a*. Although some blocks of the method **700** are indicated as occurring within certain components of the system **100***a*, it is to be understood that the system **100***a* or the method **700** can be varied, and need not work as discussed herein in conjunction with each other. In addition, it is to be appreciated that the method **700** need not be performed in the exact sequence as shown, hence the elements of the method are referred to herein as "blocks" rather than "steps". For example, a person skilled in the art will appreciate with the benefit of these teachings that the order of some blocks can be interchanged and that some blocks can also be performed in parallel.

Beginning at Block **710**, the central controller **308***a* establishes a communication link via the plurality of relay antennas **304***a*-**1**, **304***a*-**2**, and **304***a*-**3** with the portable electronic device **104***a*. The manner in which the Block **710** establishes a communication link is not particularly limited and can include the manners discussed in connection with Block **510**.

Block **720** comprises locating the portable electronic device **104***a* based on input data received from the plurality of relay antennas **304***a*-**1**, **304***a*-**2**, and **304***a*-**3**. The manner by which the Block **720** locates the portable electronic device is not particularly limited and can include the manners discussed above in connection with Block **530**.

Block **730** comprises determining whether the portable electronic device **104***a* is located within the driver zone **312***a*. The manner by which the Block **730** makes the determination is not particularly limited and can include the manners discussed above in connection with Block **630**. If the portable electronic device **104***a* is not in the driver zone **312***a*, the method **700** leads to Block **740**. Alternatively, if the portable electronic device **104***a* is in the driver zone **312***a*, the method **700** leads to Block **750**.

Block **740** comprises relaying communications messages between the portable electronic device **104***a* and the base station **108***a*. The manner by which the Block **740** relays communications messages is not particularly limited and can include the manners discussed above in connection with Block **520**.

Block **750** comprises determining whether the vehicle **300***a* is travelling above a predefined threshold speed. The manner by which the determination can be made is not particularly limited. In the present embodiment, the central controller **308***a* receives vehicle messages from a vehicle computer which includes an indication of the speed at which the vehicle **300***a* is travelling. In other embodiments, the portable electronic device **104***a* can include a GPS system or a speed sensor which can determine the speed at which the portable electronic device **104***a*, and thus the vehicle **300***a*, is travelling. If the speed is below the predefined threshold value, the execution of Block **750** results in "no", and lead to Block **740**. Alternatively, if the speed is above the predefined threshold value, the execution of Block **750** results in "yes", and lead to Block **760**.

Block **760** is the end of method **700**. It is to be appreciated that the message is never relayed to the portable electronic device **104***a* in this embodiment. Therefore, the portable electronic device **104***a* is effectively disabled such that the portable electronic device **104***a* can no longer communicate with the base station **108***a* via the relay system **302***a*. In the present embodiment, messages received by the central controller **308***a* are stored in the memory unit **358***a* and withheld from the portable electronic device **104***a* until the method **700** permits the central controller **308***a* to relay messages to the portable electronic device **104***a*. However, in other embodiments, the messages can simply never be delivered or returned to a portable electronic device of the sender with notification of a failed delivery.

It is to be understood that many combinations, variations and subsets of the embodiments and teachings herein are contemplated. As a non-limiting example, it is to be appreciated that Block **650** of method **600** can be interchanged with clock **760** of the method **700**. Both blocks **650** and **760** effectively disable the portable electronic device **104***a* in conditions where the portable electronic device **104***a* should not be used as inferred by the location of the portable electronic device. As a non-limiting example of a variation, the execution of Block **650** or **760** can also include automatically returning a message to a second portable electronic device of a sender trying to contact the portable electronic device **104***a* to alert the second portable electronic device that the portable electronic device **104***a* is unavailable for a communication

session. As a non-limiting example of a variation, a warning message indicating that the delivery of the communication message will be delayed can be sent to the portable electronic device of the sender.

Referring now to FIG. **12**, a schematic representation of a non-limiting example of a system **100***d* demonstrates how location information of a portable electronic device **104***d* can be incorporated into the LTE Architecture. The system **100***d* includes a base station (eNodeB) **322***d* in the LTE system, a mobility management entity (MME) **324***d*, evolved serving mobile location centre **326***d* (E-SMLC), Gateway Mobile Location Centre (GMLC) **328***d*, serving gateway **330***d*, a packet data network (PDN) gateway **332***d*, operator Internet protocol services **334***d*, and a policy control and charging rule function (PCRF) **336***d*,

The eNodeB **322***d* is a base station for communicating with the portable electronic device over a wireless transmission link. In the present embodiment, the eNodeB **322***d* is in communication with the vehicle **300***d* via a LTE-Uu radio interface between the vehicle **300***d* and the eNodeB **322***d* in present embodiment.

The MME **324***d* is a key control-node in LTE access network. A responsibility of the MME **324***d* is tracking an idle location of the relay system of the vehicle **300***d* in the present embodiment. In the present embodiment, the MME **324***d* is in communication with the eNodeB **322***d* using a S1-MME interface. In particular, the S1-MME interface can be used to deliver signaling messages between the MME **324***d* and the eNodeB **322***d*.

The E-SMLC **326***d* manages the overall co-ordination and scheduling of resources for the location of the portable electronic device **104***d*. In particular, the E-SMLC **326***d* communicates with the portable electronic device **104***d*, via the MME **324***d*, the eNodeB **322***d*, and the relay system in the vehicle **300***d*, for location services and assistance data delivery using the LTE Positioning Protocol (LPP). In the present embodiment, the E-SMLC **326***d* is in communication with the MME **324***d* via a SLs interface.

The LPP is not particularly limited and variations are contemplated. For example, in some embodiments, messages of the LPP can be modified to carry location information of both the vehicle **300***d* and the portable electronic device **104***d*.

As another example, messages of the LPP can further be modified to carry information associated with the location relationship between the vehicle **300***d* and the portable electronic device **104***d* such as to report a coupling relationship between the vehicle **300***d* and the portable electronic device **104***d* to a server. For example, the RequestCapabilities message body in a LPP message can be used by the server to request the device capability information for LPP and the supported individual positioning methods:

```
RequestCapabilities-r9-IEs ::= SEQUENCE {
    commonIEsRequestCapabilities        CommonIEsRequestCapabilities        OPTIONAL,   -- Need ON
    a-gnss-RequestCapabilities          A-GNSS-RequestCapabilities          OPTIONAL,   -- Need ON
    otdoa-RequestCapabilities           OTDOA-RequestCapabilities           OPTIONAL,   -- Need ON
    ecid-RequestCapabilities            ECID-RequestCapabilities            OPTIONAL,   -- Need ON
    relative-pos-RequestCapabilities    RELATIVE-POS-RequestCapabilities    OPTIONAL,   -- Need ON
    epdu-RequestCapabilities            EPDU-Sequence                       OPTIONAL,   -- Need ON
        ...
}
```

In another example, the ProvideCapabilities message body in a LPP message can indicate the LPP capabilities of the target device to the server. The ProvideCapabilities message can be modified to the following:

```
RequestCapabilities-r9-IEs ::= SEQUENCE {
    commonIEsRequestCapabilities        CommonIEsRequestCapabilities        OPTIONAL,   -- Need ON
    a-gnss-RequestCapabilities          A-GNSS-RequestCapabilities          OPTIONAL,   -- Need ON
    otdoa-RequestCapabilities           OTDOA-RequestCapabilities           OPTIONAL,   -- Need ON
    ecid-RequestCapabilities            ECID-RequestCapabilities            OPTIONAL,   -- Need ON
    relative-pos-RequestCapabilities    RELATIVE-POS-RequestCapabilities    OPTIONAL,   -- Need ON
    epdu-RequestCapabilities            EPDU-Sequence                       OPTIONAL,   -- Need ON
    ...
}
```

In another example, the CommonIEsProvideLocationInformation carries common information elements for a Provide Location Information LPP message Type. This message can be modified to include the position of a device relative to the vehicle:

```
CommonIEsProvideLocationInformation ::= SEQUENCE {
    locationEstimate                LocationCoordinates     OPTIONAL,
    velocityEstimate                Velocity                OPTIONAL,
    locationError                   LocationError           OPTIONAL,
    ...
}
LocationCoordinates ::= CHOICE {
    ellipsoidPoint                                          Ellipsoid-Point,
    ellipsoidPointWithUncertaintyCircle                     Ellipsoid-PointWithUncertaintyCircle,
    ellipsoidPointWithUncertaintyEllipse                    EllipsoidPointWithUncertaintyEllipse,
    polygon                                                 Polygon,
    ellipsoidPointWithAltitude                              EllipsoidPointWithAltitude,
    ellipsoidPointWithAltitudeAndUncertaintyEllipsoid       EllipsoidPointWithAltitudeAndUncertaintyEllipsoid,
    ellipsoidArc                                            EllipsoidArc,
    relativePosition                { anchorUEID,
                                      relativePosToAnchor };
    ...
}
Velocity ::= CHOICE {
    horizontalVelocity                                      HorizontalVelocity,
    horizontalWithVerticalVelocity                          HorizontalWithVerticalVelocity,
    horizontalVelocityWithUncertainty                       HorizontalVelocityWithUncertainty,
    horizontalWithVerticalVelocityAndUncertainty            HorizontalWithVerticalVelocityAndUncertainty,
    relativeVelocity                        {   anchorUEID,
                                                relativeVelocityToAnchor };
    ...
}
```

The GMLC **328***d* handles requests for location information from the MME **324***d* and responds to the requests. In the present embodiment, the GMLC **328***d* is in communication with the MME **324***d* via a SLg interface. In particular, the GMLC **328***d* performs a location service (LCS) subscription authorization function.

The serving gateway **330***d* is acts as a mobility anchor during a handover from the eNodeB **322***d* to another eNodeB (not shown). In the present embodiment, the serving gateway **330***d* is in communication with the eNodeB **322***d* via a S1-U interface. In addition, the serving gateway **330***d* is in communication with the MME **324***d* via a S11 interface.

The PDN gateway **332***d* provides connectivity from the vehicle **300***d* to external packet data networks by being the point of exit and entry of traffic for the vehicle **300***d*. In the present embodiment, the PDN gateway **332***d* is in communication with the serving gateway **330***d* via a S5/S8 interface.

The PCRF **336***d* is a policy manager of 4G LTE technology. The PCRF **336***d* manages and control data sessions, and provides an interface for a billing and charging system. In the present embodiment, the PCRF **336***d* is in communication with the PDN gateway **332***d* via a Gx interface.

In the present embodiment, in addition to storing the location information of vehicle **300***d*, the E-SMLC **326***d* can be further configured to receive location information of the portable electronic device **104***a* associated with the vehicle **300***d*. It is to be appreciated, with the benefit of this description that location queries can be processed at the E-SMLC **326***d* generate a notification of whether the portable electronic device **104***d* is in driver zone of the vehicle **300***d*. For example, if the portable electronic device **104***d* is in the driver zone (not shown in this embodiment), when the vehicle **300***d* is in a curving section of a highway, the response from E-SMLC **326***d* can be used to redirect an incoming call to a voice mailbox. In other embodiment, the relay system of the vehicle **300***d* can delay and store a text message for subsequent delivery as described in a previous embodiment.

It is to be appreciated, with the benefit of this specification, that know the location of a portable electronic device **104***d* in a vehicle **300***d* can enable future vehicle-related applications and service such as car-to-car or passenger-to-passenger communication or cross-vehicle interaction (sharing or play music/video/photos/games). In some embodiments, third-party services can access the in-car location information to push messages to a portable electronic device **104***d* in a specific location of the vehicle **300***d*. For example, toll charge invoices/receipts can be sent to a portable electronic device in the driver zone after the vehicle passes through a toll booth. As another example. tourist/local information can be broadcasted to a portable electronic device in the passenger zone as the vehicle **300***d* enters a predefined area.

Referring to FIG. **13**, a schematic representation of another non-limiting example of a system **100***e* for communicating with a portable electronic device is shown. Like components of the system **100***e* bear like reference to their counterparts in the system **100***d*, except followed by the suffix "e" instead of "d". The system **100***e* includes an eNodeB **322***e*, a MME **324***e*, an E-SMLC **326***e*, a GMLC **328***e*, a serving gateway **330***e*, a PDN gateway **332***e*, operator Internet protocol services **334***e*, and a PCRF **336***e*.

In the present embodiment, the relay system of the vehicle **300***e* connects to the eNodeB **322***e* via the portable electronic device **104***e*. The portable electronic device **104***e* establishes a connection with the eNodeB **322***e* before interacting with the relay system of the vehicle **300***e*. In this embodiment, it is to be appreciated that the portable electronic device **104***e* relays the location information of the vehicle **300***e* to the E-SMLC **326***e*.

Referring now to FIG. **14**, a schematic representation of another non-limiting example of a system **100***f* demonstrates how location information can be used to notify a first portable electronic device **190***f* of the status of a second portable electronic device **104***f*. The system **100***f* includes a radio access network **108***f*, a packet switching (PS) domain **338***f*, an XML document manager (XDM) server **340***f*, an IP multimedia subsystem (IMS) domain **342***f*, and a presence server **344***f*,

In the present embodiment, the radio access network **108***f* is generally configured to provide radio communication between the portable electronic device **190***f* and the PS domain **338***f* as well as between the vehicle **300***f* and the PS domain **338***f*. It is to be appreciated that the type of radio communication is not particularly limited and can include a variety of different types such as those discussed above in connection with previously described embodiments.

The PS domain **338***f* is the backbone packet switching network. In the present embodiment, the PS domain **338***f* is in communication with the radio access network **108***f*.

The XDM server **340***f* is responsible for handling the management of XML documents, such as presence authorization rules, static presence information, contact and group lists (also known as resource lists), policy data, and many others. In the present embodiment, the XDM server **340***f* is in communication with the PS domain **338***f* using the XML configuration access protocol.

The IP multimedia subsystem (IMS) domain **342***f* handles multimedia traffic in the network. In the present embodiment, the IMS domain **342***f* is in communication with the PS domain **338***f* via a session initial protocol (SIP).

The presence server **344***f* is generally configured to determine if the portable electronic device **104***f* is in a driver zone in the present embodiment. The presence server **344***f* is in communication with the IMS domain **342***f* via a link similar to the link connecting the IMS domain **342***f* to the PS domain **338***f*. It is to be appreciated that when a first portable electronic device **190***f* calls the second portable electronic device, the presence server **344***f* can be configured to determine whether features of the second portable electronic device **104***f* should be restricted, such as when it is in a driver zone. If the portable electronic device **104***f* should be restricted, the presence server **344***f* can be configured to send a message to the first portable electronic device **190***f* indicating that the portable electronic device **104***f* is unavailable to receive a call.

While specific embodiments have been described and illustrated, such embodiments should be considered illustrative only and should not serve to limit the accompanying claims.

What is claimed is:

1. A system for communicating with a portable electronic device, the system comprising:

a plurality of relay antennas mounted to a vehicle, each relay antenna of the plurality of relay antennas configured to communicate with the portable electronic device; and

a processor in communication with the plurality of relay antennas, the processor configured to relay a communication message between the portable electronic device and a base station, the processor further configured to:

locate the portable electronic device based on input data received from the plurality of relay antennas; and to

send location information of the portable electronic device to the base station, the location information including an indication of whether the portable electronic device is located in a driver zone or a passenger zone of the vehicle, the location information configured to trigger a change in messaging behaviour for the portable electronic device at a network device, depending on whether the portable electronic device is located in the driver zone or the passenger zone, and the change in messaging behaviour includes forwarding an incoming call to voicemail or delaying and storing an incoming text message.

2. The system of claim **1**, wherein the processor is configured to send a control message to the portable electronic device based on a location of the portable electronic device.

3. The system of claim **2**, wherein the control message is for modifying a feature of the portable electronic device.

4. The system of claim **3**, wherein the processor is configured to withhold the communication message associated with the modified feature of the portable electronic device, the processor further configured to store the communication message in a memory storage unit.

5. The system of claim **1**, further comprising a vehicle interface configured to receive a vehicle message from a vehicle computer.

6. The system of claim **5**, wherein the vehicle message provides an indication of a speed of the vehicle.

7. The system of claim **6**, wherein the processor is configured to send a control message to the portable electronic device based on a location of the portable electronic device and the speed of the vehicle.

8. The system of claim **7**, wherein the control message is for modifying a feature of the portable electronic device.

9. The system of claim **1**, further comprising an external antenna in communication with the processor, the external antenna configured to communicate with the base station.

10. The device of claim **1**, wherein the processor is further configured to: in response to the sending the location information, receive content customized for the driver zone or the passenger zone depending on whether the portable electronic device is located in the driver zone or the passenger zone.

11. The method of claim **1**, further comprising: in response to the sending the location information, receiving content customized for the driver zone or the passenger zone depending on whether the portable electronic device is located in the driver zone or the passenger zone.

12. A method of communicating with a portable electronic device, the method comprising:

establishing a communication link between the portable electronic device and a plurality of relay antennas via a relay system;

relaying a communication message between the portable electronic device and a base station using the relay system;

locating the portable electronic device based on input data from the plurality of relay antennas; and

sending location information of the portable electronic device from the relay system to the base station, the location information including an indication of whether the portable electronic device is located in a driver zone or a passenger zone of a vehicle, the location information configured to trigger a change in messaging behaviour for the portable electronic device at a network device, depending on whether the portable electronic device is located in the driver zone or the passenger zone, and the change in messaging behaviour includes forwarding an incoming call to voicemail or delaying and storing an incoming text message.

13. The method of claim **12**, further comprising executing a control command at the portable electronic device based on a location of the portable electronic device.

14. The method of claim **13**, wherein sending the control message is for modifying a feature of the portable electronic device.

15. The method of claim **14**, further comprising withholding the communication message associated with the modified feature of the portable electronic device.

16. The method of claim 15, further comprising storing the withheld communication message in the memory storage unit.

17. The method of claim 12, further comprising receiving a vehicle message from a vehicle computer.

18. The method of claim 17, wherein the vehicle message provides an indication of a speed of the vehicle.

19. The method of claim 18, further comprising sending a control message to the portable electronic device based on a location of the portable electronic device and the speed of the vehicle.

20. The method of claim 12, further comprising communicating with the base station using an external antenna.

* * * * *